OPTIMUM®

MASCHINEN - GERMANY

Operating manual

Version 1.0

Technical specification

Safety instructions

Calculating the required clamping force for a given speed

Scope of delivery

Assembly

Lubricating and cleaning the lathe chuck

Appendix

Four-jaw Manual Power Chuck K12-160

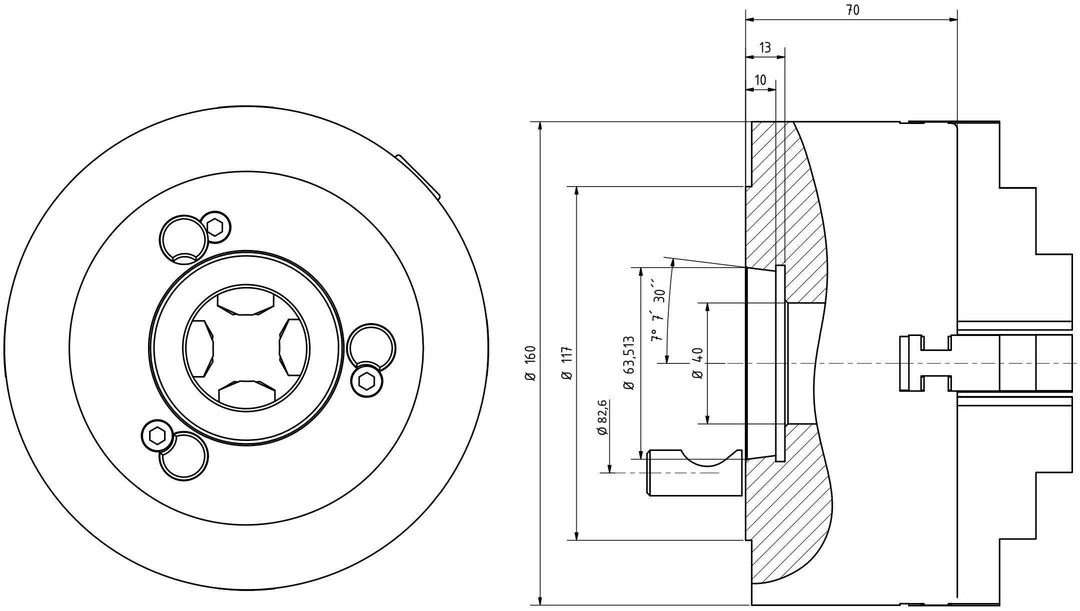
centric clamping

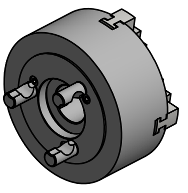
Ø 160 mm

DIN ISO 702-2 (Camlock)

Item no..

3442840





Preface

Dear customer,

Thank you very much for purchasing a product made by OPTIMUM.

OPTIMUM metal working machines offer a maximum of quality, technically optimum solutions and convince by an outstanding price performance ratio. Continuous enhancements and product innovations guarantee state-of-the-art products and safety at any time.

Before commissioning the machine please thoroughly read these operating instructions and get familiar with the machine. Please also make sure that all persons operating the machine have read and understood the operating instructions beforehand.
Keep these operating instructions in a safe place nearby the machine.

Information

The operating instructions include indications for safety-relevant and proper installation, operation and maintenance of the machine. The continuous observance of all notes included in this manual guarantee the safety of persons and of the machine.

The manual determines the intended use of the machine and includes all necessary information for its economic operation as well as its long service life.

In the paragraph "Maintenance" all maintenance works and functional tests are described which the operator must perform in regular intervals.

The illustration and information included in the present manual can possibly deviate from the current state of construction of your machine. Being the manufacturer we are continuously seeking for improvements and renewal of the products. Therefore, changes might be performed without prior notice. The illustrations of the machine may be different from the illustrations in these instructions with regard to a few details. However, this does not have any influence on the operability of the machine.
Therefore, no claims may be derived from the indications and descriptions. Changes and errors are reserved!

Your suggestion with regard to these operating instructions are an important contribution to optimising our work which we offer to our customers. For any questions or suggestions for improvement, please do not hesitate to contact our service department.

If you have any further questions after reading these operating instructions and you are not able to solve your problem with a help of these operating instructions, please contact your specialised dealer or directly the company OPTIMUM.

Optimum Maschinen Germany GmbH

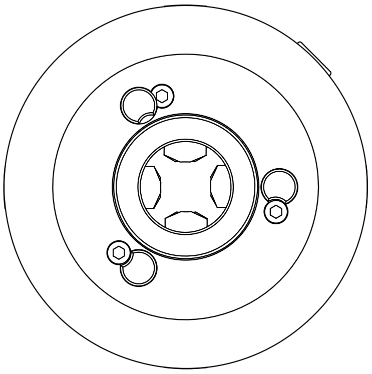
Dr.- Robert - Pfleger - Str. 26

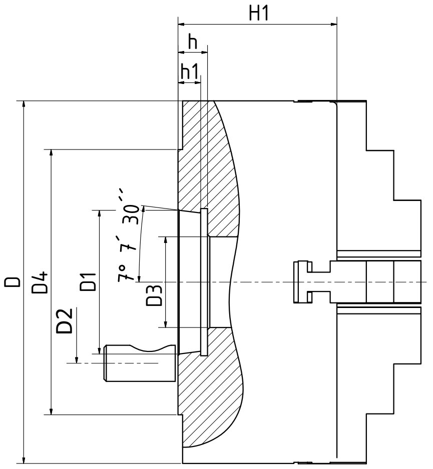
D-96103 Hallstadt, Germany

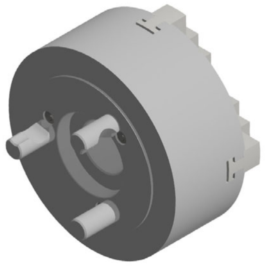
Email: info@optimum-maschinen.de

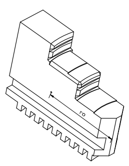
1 Technical specification

1.1 Rotary chuck - K12-160 ISO 702-2







<table>
<tr><td colspan="2">Type</td><td>K12-160/D4
(3442840)</td></tr>
<tr><td colspan="2">Material of the chuck body</td><td>Cast steel</td></tr>
<tr><td colspan="2">Camlock direct fixing (without flange)</td><td>DIN ISO 702-2
Size no. 4</td></tr>
<tr><td colspan="2">maximum clamping diameter [mm]</td><td>160</td></tr>
<tr><td colspan="2">Lathe chuck passage [mm]</td><td>40</td></tr>
<tr><td colspan="2">max. speed [rpm]</td><td>2150</td></tr>
<tr><td colspan="2">max. static clamping force $\sum_S$ [kN]</td><td>24</td></tr>
<tr><td colspan="2">Maximum torque with lathe chuck key [Nm]</td><td>160</td></tr>
<tr><td colspan="2">Lathe chuck weight [kg]</td><td>10</td></tr>
<tr><td>Weight of a jaw [kg]
with internal grading</td><td rowspan="4"></td><td>0.315</td></tr>
<tr><td>Mass of chuck jaw set [kg]</td><td>1.26</td></tr>
<tr><td>Centrifugal moment M_c for one jaw [kgm]
with internal grading</td><td>0.01636</td></tr>
<tr><td>Gravity distance r_o of jaw [mm]</td><td>40.98</td></tr>
<tr><td colspan="2">D</td><td>160</td></tr>
<tr><td colspan="2">D1</td><td>63.513</td></tr>
<tr><td colspan="2">D2</td><td>82.6</td></tr>
<tr><td colspan="2">D3</td><td>40</td></tr>
<tr><td colspan="2">D4</td><td>117</td></tr>
<tr><td colspan="2">H_1</td><td>71</td></tr>
<tr><td colspan="2">h</td><td>13</td></tr>
<tr><td colspan="2">h_1</td><td>10</td></tr>
</table>

2 Safety instructions

2.1 Intended use

This standard product is suitable for clamping workpieces on lathe machines and other rotating tooling machines. Unintended and improper use of the manual chuck may cause danger to life and limb of the operator. The specified maximum technical data must not be exceeded while the manual chuck is in operation! The manual chuck should only be used on the basis of its technical data. This also comprises the observance of the conditions of initial operation, assembly, operation as well as conditions of environment and maintenance provided by the manufacturer.

For each individual clamping task, the permitted rotational speed and the necessary clamping force must be determined according to the respective standards that apply and/or the most up-to-date scientific and technological data (e.g. VDI 3106).

2.2 Reasonably foreseeable misuses

Any other use other than that specified under "Intended use" or any use beyond the described use shall be deemed as non-intended use and is not permissible.

Any other use has to be discussed with the manufacturer.

In order to avoid misuse, it is necessary to read and understand the operating instructions before the first commissioning.

The operators must be qualified.

2.2.1 Avoiding misuse

Improper and unintended use of the manual chuck and disregard of the current safety norms and safety regulations can threaten life and limb of the operator. Irrespective of whether our chucks are used under rotation or stationary, it is mandatory to wear protective equipment in accordance with the EC machine guideline, so that loose parts, discharged in case of the chuck or a component malfunctioning, are absorbed by the protective equipment. The machine manufacturer must ensure that there is a sufficient wall thickness of its housing / protection equipment (considering the currently valid directives and standards), because this may cause a threat to the life and limb of the operator in the case of a fracture in the chuck jaws, or when the workpiece gets lost.

DANGER!

Regularly check the clamping force by inserting a power meter in the lathe chuck.

CAUTION!

Risk of damages due to incorrect choice of clamping position for chuck jaws on workpiece. If an incorrect clamping position is chosen for the chuck jaws on workpiece, the lathe chuck jaws may be damaged. The external diameter of jaws must not exceed the external diameter of the chuck by more than max. 10%.

CAUTION!

Hazard from vibration due to imbalanced rotating parts and noise generation. Physical and mental strains due to imbalanced workpieces and noise during the machining process on the clamped and rotating workpiece.

- Ensure the chuck's axial and concentric runout.
- Check options for remedying imbalances on workpieces.
- Reduce the speed.
- Wear hearing protection.
- If the chuck is involved in a collision, it must be subjected to a crack test before using it again.

2.3 Basic safety instructions

- The permissible speed (as per VDI 3106) must be calculated for the machining allowance; the maximum guide speed must not be exceeded. The calculated values must be tested by performing a dynamic measurement.
- The max. guide speed may only be applied with max. introduced actuation force and a chuck that is perfect working condition.
- If the chuck is involved in a collision, it must be subjected to a crack test before using it again. Damaged parts must be replaced using original spare parts.
- The chuck may only be mounted and removed, commissoned, operated and maintained by authorised and skilled staff following safety training.
- We recommend checking the clamping force before starting a new series batch and between maintenance intervals with a clamping force measuring device. Only regular checks guarantee best possible safety.

2.3.1 Optional soft lathe chuck jaws

CAUTION!

The optionally available soft chucks jaws are jaws, which must be stepped according to the application. Unstepped jaws lead to an increased centrifugal torque with a reduced permissible rotational speed of the rotary chuck.

3 Calculating the required clamping force for a given speed

The initial clamping force F_{sp0} is the total force impacting radially on the workpiece via the jaws due to actuation of the lathe chuck during shutdown. Under the influence of rpm, the jaw mass generates an additional centrifugal force. The centrifugal force reduces or increases the initial clamping force depending on whether gripping takes place from the outside in or from the inside out. The sum of the initial clamping force F_{sp0} and the centrifugal force F_c , is the effective clamping F_{sp}.

$F_{sp} = F_{sp0} \pm F_c$ [N]

- for gripping from the outside in
+ for gripping from the inside out

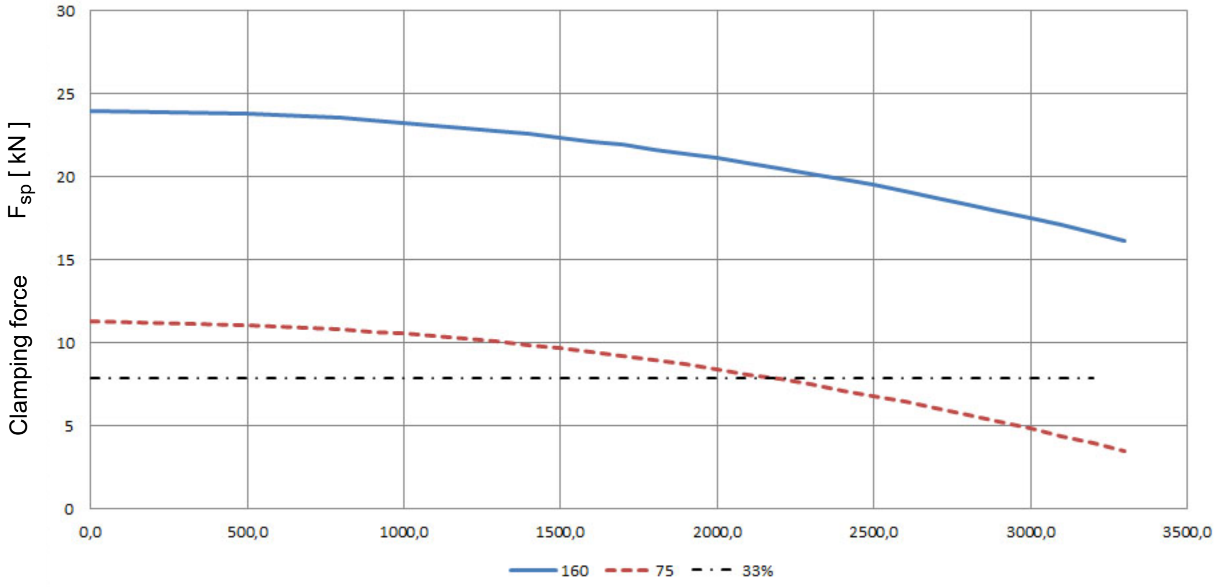
Legend			
F_c	Total centrifugal force [N]	M_{cAB}	Centrifugal force of top jaws in [
F_{sp}	Effective clamping force [N]	M_{cGB}	Centrifugal force of base jaws in [
F_{spmin}	Required static clamping force [N	n	Rotational speed [rpm]
F_{sp0}	Initial clamping force [N]	r_s	Center of gravity radius [mm]
F_{spz}	Cutting force [N]	r_{sAB}	Center of gravity radius of top jaw
m_{AB}	Mass of one top jaw [kg]	s_{sp}	Clamping force safety factor
m_B	Mass of chuck jaw set [kg]	s_z	Safety factor for cutting
M_c	Centrifugal force torque [kgm]	Σ_s	Max. Clamping force of the chuck [
1 Newton (N) = 1 kg m/s²			

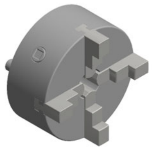
DANGER!

Risk to life and limb of the operating personnel and significant property damage when the RPM limit is exceeded! With gripping from the outside inwards, and with increasing RPM, the effective clamping force is reduced by the magnitude of the increasing centrifugal force (the forces are opposed). When the RPM limit is exceeded, the clamping force drops below the minimum clamping force F_{spmin} Consequently, the workpiece is released in an unchecked manner.

- o Do not exceed the calculated RPM.
- o Do not fall below the necessary minimum clamping force.

3.1 Clamping force-speed diagram - Lathe chuck K12-160





- - - - Required minimum clamping force 33 %

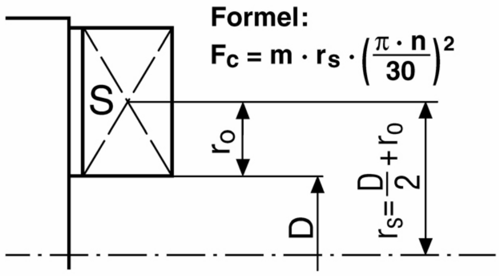
– – – – Tightening torque with key 75 Nm

——— Tightening torque with key max. 160 Nm

The clamping force to speed diagram shows the calculated centrifugal force with the matching jaw design as a function for the speed if the chuck jaws do not protrude beyond the outer diameter of the chuck.

3.2 Clamping jaw centrifugal force

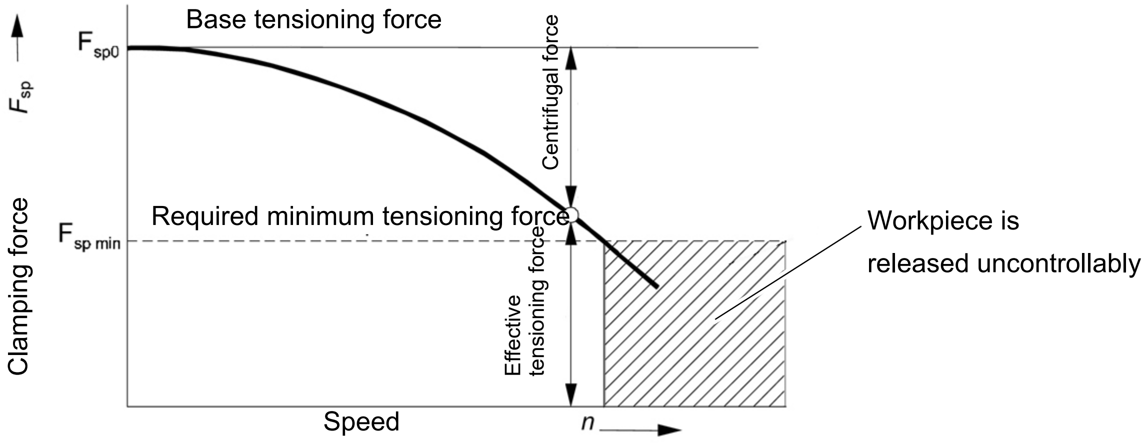
To calculate the required tensioning force for processing a workpiece, the centrifugal force of the clamping jaws must be taken into account.



$$F_C = m \cdot r_S \cdot \left(\frac{\pi \cdot n}{30}\right)^2$$

Fc	Centrifugal force in N
m	Mass in kg/set
rs	Centre of gravity distance to the centre of the chuck in metres
n	Speed min^{-1}
r_0	Centre of gravity distance to the clamping jaw

The permissible speeds can be determined in accordance with VDI Guideline 3106 "Determining the permissible speed for lathe chucks (jaw chucks). This guideline also allows for the residual tensioning force at a specified speed to be determined.



The required effective clamping force for machining F_{sp} is calculated from the product of the machining force F_{spz} with the safety factor S_z. This factor takes into account uncertainties in the calculation of the clamping force.

According to VDI 3106, the following also applies here:

$$F_{sp} = F_{spz} \cdot S_z \text{ [N]}$$

From this we can derive the calculation of the initial clamping force during shutdown:

$$F_{sp0} = S_{sp} \cdot (F_{sp} \pm F_c) \text{ [N]}$$

- for gripping from the outside in
+ for gripping from the inside out

ATTENTION!

This calculated force must not be larger than the maximum clamping force $\sum_S$ (24 KN) engraved on the chuck.

From the above formula it is evident that the sum of the effective clamping force F_{sp} and the total centrifugal force F_c is multiplied by the safety factor for the clamping force S_{sp}.

According to VDI 3106, the following also applies here: $S_{sp} \geq 1.5$

The total centrifugal force F_c is dependent both on the sum of the masses of all jaws and on the center of gravity radius and the RPM.

ATTENTION!

For safety reasons, in accordance with DIN EN 1550, the centrifugal force may be a maximum of 67% of the initial clamping force.

The formula for the calculation of the total centrifugal force F_c is:

$$F_c = \sum (m_b \cdot r_s) \cdot \left(\frac{\pi \cdot n}{30}\right)^2 = \sum M_c \cdot \left(\frac{\pi \cdot n}{30}\right)^2 \text{ [N]}$$

n is the given speed in r.p.m.. The product $\mathbf{m_B \cdot r_s}$ is described as the centrifugal force torque $\mathbf{M_c}$.

$$M_c = m_B \cdot r_s \text{ [kgm]}$$

In case of chucks with split chuck jaws, i.e. with base jaws and top jaws, for which the base jaws change their radial position only by the stroke amount, the centrifugal torque of base jaws M_{cGB} and the centrifugal torque of top jaws M_{cAB} need to be added:

$$M_c = M_{cGB} + M_{cAB} \text{ [kgm]}$$

The centrifugal torque of the base jaws M_{cGB} can be found in the data of the lathe chuck.

The centrifugal torque of the top jaws M_{cAB} is calculated.

$$M_{cAB} = m_{AB} \cdot r_{sAB} \text{ [kgm]}$$

The lathe chuck K12-160 has no base jaws and no top jaws.

Example:

- The centre of gravity radius r_s of the jaw = 0.05196 m (jaw flush with the outer diameter of the chuck)
- Weight of a jaw = 0.315kg
- Centrifugal moment for one jaw

$$M_c = 0.315 \text{ kg} \cdot 0.05196 \text{ m} = 0.01636 \text{ kgm}$$

- The lathe chuck has 4 jaws.

$$= 0.01636 \text{ kgm} \cdot 4 = 0.0654 \text{ kgm}$$

- Calculation of the total centrifugal force at a rotational speed of 2150 rpm

$$F_c = \sum (m_b \cdot r_s) \cdot \left(\frac{\pi \cdot n}{30}\right)^2 = \sum M_c \cdot \left(\frac{\pi \cdot n}{30}\right)^2 \text{ [N]}$$

$$= 0.0654 \text{ kgm} \cdot \left(\frac{3.14 \cdot 2150}{30}\right)^2 = 3311.85 \text{ N} = 3.3 \text{ kN}$$

The total possible clamping force of the chuck at a standstill is $\sum_s$ 24 kN at a tightening torque of 160 Nm with the lathe chuck key.

An effective clamping forceF_{sp} of 20.7 kN remains at the chuck.

$$F_{sp} = \sum_s - F_c = 24 \text{ kN} - 3.3 \text{ kN} = \mathbf{20.7\ kN}$$

see ► Clamping force-speed diagram - Lathe chuck K12-160 on page 6

see ► Basic safety instructions on page 5

WARNING!

The greater distance above the chuck surface that clamping occurs, the lower the clamping force will be.

3.3 Notes on instruction of operating personnel

We recommend that the business operating our manual chucks makes the operating instructions in particular thesection "Safety" available to all persons being in charge of operation, maintenance and repair, with the intention ofacquiring specialised knowledge. We further recommend that the business operator issues internal "operating instructions" which take into account the known qualifications of the operating personnel.

The business operator must guarantee that suitable measures in organisation and instruction are taken to ensure that the appropriate safety rules and regulations are complied with by the persons entrusted with operation, aintenance and repair of the manual chuck.

4 Scope of delivery

Note: Soft, non-stepped jaws are only available as an option.

- 1 manual clamping chuck (complete) with camlock bolt for direct fixing of the chuck on a lathe as per DIN ISO 702-2 , size depending on the spindle size.
- 1 set of internal clamping jaws, centric clamping
- 1 set of external clamping jaws, centric clamping
- 1 clamping key without ejector
- 1 Operating manual

5 Assembly

5.1 Assembly of the manual chuck

5.1.1 Handling before mounting

Actuate the chuck before assembly on the lathe. Turn the spindle to the left by means of the clamping key until it stops.

The numbered jaws have to be pushed into the correspondingly numbered guidance (jaw 1 into guidance 1 etc.)

Finally turn the spindle several times to the right and to the left until it bottoms out.

5.1.2 Preparing the chuck attachment

Check the head of the machine spindle or the ready-machined intermediate flange on true-running and face play. The contact face has to be chamfered and clean at the bores. Remove possible damages at the mounting faces of the spindle head. In case of flange spindles, the contact face has to be checked with a straight edge. For fastening with an intermediate flange please note that the flange needs full contact with the chuck body. The flange must be supported by the whole face.

5.1.3 Mounting of the manual chuck

Thoroughly clean the centering and the bearing surfaces of both parts and lubrify them with oil before placing the chuck onto the spindle head. When the chuck is slightly pressed, there should be a noticeable play and between the faces there should be a gap of max. 0.02 mm (feeler gauge).

6 Lubricating and cleaning the lathe chuck

ATTENTION!

Do not use compressed air to remove dust and foreign substances from the lathe chuck.

Coolant squirts on the lathe chuck and removes the grease from the master jaws. In order to maintain the tensioning force and the long-term accuracy of the lathe chuck, the lathe chuck must be lubricated regularly. Insufficient lubrication will result in malfunctions at reduced tensioning force, which affects the accuracy and causes excessive wear and seizing.

Depending on the chuck type and operating state, the tensioning force of a lathe chuck can decrease by up to 50 percent of the nominal tensioning force.

A presumably securely clamped workpiece can then fall out of the chuck during processing.

Oil the chuck regularly at the oiler. Use additional an lubricant on the toothing of the clamping jaws, which is of high quality and for high pressure bearing surfaces. The lubricant should withstand the coolant and other chemicals.

7 Appendix

7.1 Liability claims/warranty

Besides the legal liability claims for defects of the customer towards the seller, the manufacturer of the product, OPTIMUM GmbH, Robert-Pfleger-Straße 26, D-96103 Hallstadt, does not grant any further warranties unless they are listed below or were promised as part of a single contractual provision.

- Liability or warranty claims are processed at OPTIMUM GmbH's discretion either directly or through one of its dealers.
  Any defective products or components of such products will either be repaired or replaced by components which are free from defects. Ownership of replaced products or components is transferred to OPTIMUM Maschinen Germany GmbH.
- The automatically generated original proof of purchase which shows the date of purchase, the type of machine and the serial number, if applicable, is the precondition in order to assert liability or warranty claims. If the original proof of purchase is not presented, we are not able to perform any services.
- Defects resulting from the following circumstances are excluded from liability and warranty claims:
  - Using the product beyond the technical options and proper use, in particular due to overstraining of the machine.
  - Any defects arising by one's own fault due to faulty operations or if the operating manual is disregarded.
  - Inattentive or incorrect handling and use of improper equipment
  - Unauthorized modifications and repairs
  - Insufficient installation and safeguarding of the machine
  - Disregarding the installation requirements and conditions of use
  - atmospheric discharges, overvoltage and lightning strokes as well as chemical influences
- The following items are also not subject to liability or warranty claims:
  - Wearing parts and components which are subject to a standard wear as intended such as e.g. V-belts, ball bearings, illuminants, filters, sealings, etc.
  - Non reproducible software errors
- Any services, which OPTIMUM GmbH or one of its agents performs in order to fulfil any additional warranty are neither an acceptance of the defects nor an acceptance of its obligation to compensate. These services neither delay nor interrupt the warranty period.
- The court of jurisdiction for legal disputes between businessmen is Bamberg.
- If any of the aforementioned agreements is totally or partially inoperative and/or invalid, a provision which nearest approaches the intent of the guarantor and remains within the framework of the limits of liability and warranty which are specified by this contract is deemed agreed.

7.2 Copyright

This document is protected by copyright. All derived rights are reserved, especially those of translation, re-printing, use of figures, broadcast, reproduction by photo-mechanical or similar means and recording in data processing systems, either partial or total.

Subject to technical changes without notice.